

0023-1785-3

"RESPONSE UNDER 37 CFR 1.116-  
EXPEDITED PROCEDURE EXAMINING  
GROUP 1725"

# 7 10/11/01  
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IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF: :  
TATSUYA TANAKA ET AL. : GROUP ART UNIT: 1725  
SERIAL NO: 09/550,331 :  
FILED: APRIL 14, 2000 : EXAMINER: TRAN  
FOR: METHOD AND APPARATUS FOR  
INJECTION MOLDING LIGHT  
METAL ALLOY

TECHNOLOGY CENTER 1700

OCT -5 2001

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REQUEST FOR RECONSIDERATION

ASSISTANT COMMISSIONER FOR PATENTS  
WASHINGTON, D.C. 20231

SIR:

In response to the Office Action dated August 15, 2001, Applicants request the reconsideration of the final rejection of Claims 1-24, for the reasons set forth below.

According to a feature of the claimed invention, an injection molding apparatus incorporates a substantially vertically extending screw extruder, and so profits from the advantages inherent in vertically oriented screw extruders for molten metal, e.g., uniform crystal grains, reduced pore formation and reduced abrasion or flexion of the extrusion screw. On the other hand, the clamping device into which the molten metal is injected is oriented to open and close horizontally. To this end, the slurry discharged from the screw extruder is turned to the horizontal direction between the extruder and the clamping device, so that the connection has a substantially vertical first channel and a horizontal second channel.

In paragraph 3 of the Office Action, Claims 1-9, 17 and 21 were rejected under 35 U.S.C. §103 as being obvious over the U.S. patent to Kono in view of the U.S. patent to Wang et al and the U.S. patent to Bradley. This is the same prior art rejection that was

applied in paragraph 4 of the first Office Action. In response to the arguments traversing this rejection in the last response, the Examiner has again alleged that it would have been obvious for those skilled in the art "to provide Wang et al's screw extruder in Kono because the extruder is use (sic) to break the growing dendrites of the solid phase into small and nearly spherical particles by the shearing force for producing a strong product" (see first paragraph of page 4 of the Office Action). However, this alleged motivation for combining Kono and Wang et al is unsupportable since no "growing dendrites" would be present in the device of Kono, if modified to incorporate the extruder screw of Wang et al.

As Wang et al describe in the paragraph beginning at line 47 of column 1, "when molten metal is agitated during cooling *below its liquidus temperature*, the dendritic primary solids will be broken into near-spherical particles suspended in the liquid metal matrix. *The viscosity of such a semi-solid slurry increases exponentially with the solid fraction*, and it exhibits a shear thinning behavior" (emphasis added). Thus, dendrites grow in accordance with the solidification of the semi-solid (thixotropic) metal -- but they would not grow in a metal in a liquid state.

According to Wang et al:

It is well known that temperature control in a cooling process as used by the invention is much more difficult and requires more accuracy compared with the heating process used by thixomolding and other prior art methods. Referring to FIG. 5 for a cross-sectional view, the barrel (54) temperature is accurately controlled by the integrated heating-and-cooling barrel jackets (with cast-in heating elements and cooling tubes). (Col. 5, lines 38-45).

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The "blending" stage in the operational cycle (61), in which the material is continuously sheared by the rotating screw and cooled by the cooling medium in the barrel jacket, is a key to the effectiveness and efficiency of the production of semi-solid materials. (Col. 6, lines 25-29).

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The temperature control in the barrel and nozzle is one of the most critical factors in the rheomolding process because when the temperature changes by

1.degree. C. in the rheomolding of the Sn-15% Pb alloy with solid weight fraction (fs) in the range of 0.3-0.5, the solid fraction will change by 3.2 to 9.9%. Therefore, temperature control with accuracy of +0.5.degree. C. or smaller is essential in the rheomolding machine design. (Col. 6, lines 54-60).

Thus, Wang et al teaches that temperature control in the barrel and nozzle is a critical factor in the rheomolding process, in order to control the solid fraction. Wang et al therefore incorporates both heating coils 25 and cooling ducts 24 surrounding the barrel 19 for the screw 18, so that the heat produced by the shearing in the blending stage can be absorbed and the metal maintained in a semi-solid state. Thus, the shearing heat produced by the screw 18 in the "blending" stage requires the presence of both heating and cooling means in order to achieve the critical temperature control taught in Wang et al; without cooling the shearing heat will raise the temperature of the metal slurry above its melting point -- it will no longer be in a thixotropic state and no dendrites will be present, or require "being broken into small and nearly spherical particles."

In contrast to this, the thixotropic slurry in Kono is maintained in its thixotropic state by the heating pairs 70a-70e (column 3, lines 24-41). No cooling is required since the mixer 32 will produce only negligible shearing heat. That is, as the Examiner has alleged, mixers inherently produce some shearing, but the mixer 32 which is provided to assure that the ratio of the solid and liquid is consistent throughout the thixotropic state (column 3, lines 46-48) is inherently incapable of producing the degree of shearing heat which would raise the temperature of the metal above its melting temperature. Kono therefore has only the heating pairs 70a-70e, and lacks cooling ducts.

It may therefore be appreciated that *those skilled in the art would not have been motivated to incorporate an extrusion screw in Kono to replace the mixer 32.* An extrusion screw would inherently generate far more shearing heat in the thixotropic metal than does the simple mixer 32, and would require the introduction of a complex temperature control system

including a cooling circuit which is entirely absent in Kono. In the absence of a cooling circuit, *the metal slurry of Kono would be melted by the shearing heat of an extruder which would be **contrary to its object of maintaining the metal in a thixotropic state***. Since it is well established that it would not be obvious to modify a reference such that it is inoperative for its intended purpose, it would clearly not have been obvious to incorporate the extruder of Wang et al into Kono.

Moreover, no motivation to "break up growing dendrites" would suggest incorporating the extruder of Wang et al into Kono, since dendrites would not grow in the fully molten material which would then exist in Kono. Since Bradley et al was only cited to teach a clamping device, Applicants respectfully submit that the rejection of paragraph 3 is improper, and request that it be withdrawn.

Claim 3 further recites that the screw extruder has an injection function of moving the extrusion screw in the axial direction. This is done in Kono by the horizontal piston 45, and not by the vertically extending mixer 32 (column 3, lines 58-65). Therefore, even if those skilled in the art were motivated to modify Kono in light of Wang et al to provide a screw extruder in Kono, which screw extruder has an injection function of moving the extrusion screw in the axial direction, those skilled in the art would replace the piston 45 of Kono with a screw, **but not the mixer 32**.

Claims 10-15 were rejected under 35 U.S.C. §103 as being obvious over Kono in view of Wang et al, Bradley et al and Rock. Rock was there cited to teach a static mixer with stirring blades connected in front of a nozzle. However, Rock merely discloses a mixer used for making metal foam from liquid alloys 5 and 13, which are fed by gravity. There is no suggestion in Rock that the mixing provided for gravity fed materials would also be applicable to the discharge of an injection molding apparatus. For this reason, and because of

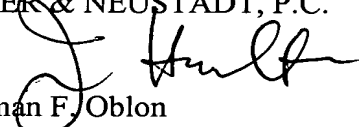
the lack of obviousness for those skilled in the art to combine Kono with Wang et al and Bradley et al, as set forth above, Applicants respectfully submit that Claims 10-15 define over any combination of the above references.

Claims 18-20 and 23 stand rejected under 35 U.S.C. §103 as being obvious over Kono, Wang et al and Bradley et al, and further in view of Mercer et al. However, regardless of what details Mercer et al might provide with respect to the teachings of the dependent claims, it provides no teaching for overcoming the shortcomings of Kono, Wang et al and Bradley et al as set forth above, and so no combination of the above references would anticipate or render obvious the subject matter of any of the claims.

Applicants therefore believe that the present application is in a condition for allowance and respectfully solicit an early Notice of Allowability.

Respectfully submitted,

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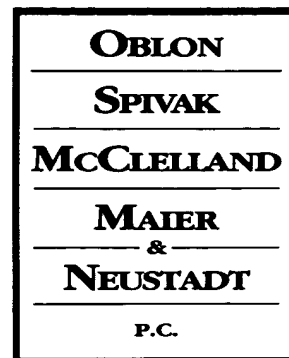
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Re: U.S. Application  
Serial No: 09/550,331  
Filed: April 14, 2000  
Group: 1725  
Inventor: Tatsuya TANAKA, et al.  
For: METHOD AND  
APPARATUS FOR  
INJECTION MOLDING  
LIGHT METAL ALLOY

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SIR:

Attached hereto for filing are the following papers:

**REQUEST FOR RECONSIDERATION (After Final)**

Our check in the amount of \$0.00 is attached covering any required fees. In the event that any variance exists between the amount enclosed and the Patent Office charges for filing the above-noted documents, including any fees required under 37 CFR 1.136 for any necessary Extension of Time to make the filing of the attached documents timely, please charge or credit our Deposit Account No. 15-0030. Further, if these papers are not considered timely filed, then a petition is hereby made under 37 C.F.R. 1.136 for the necessary extension of time. A duplicate copy of this sheet is attached.

Respectfully submitted,

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